

INGALS. (E. F.)

Intubation of the Larynx.

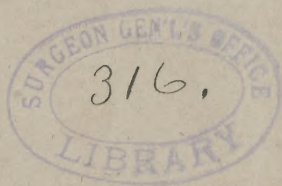
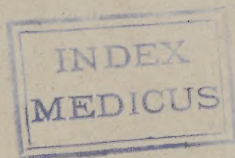
BY

E. FLETCHER INGALS, M.D.,

CHICAGO.

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INTUBATION OF THE LARYNX.*

BY E. FLETCHER INGALS, M. D.,

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IN 1858 an attempt was made by M. Bouchut, of Paris, to treat stenosis of the larynx by intubation. As the result of his experiments he reported seven cases to the Academy of Medicine, of which five were fatal and but two ended in recovery after the subsequent performance of tracheotomy. Although these results were unsatisfactory, had M. Bouchut displayed the perseverance, patience, and moderation which have characterized the author of more recent experiments, he might then have demonstrated the practical utility of the method; but, in his zeal for the new operation, he unfortunately attacked tracheotomy and brought upon himself and his method the severe criticisms of those who had seen much good accomplished by opening the trachea. Trousseau, as secretary of the commission appointed to investigate the new operation, reported:

1. Tubage of the larynx in certain cases of acute laryngitis can, by retarding asphyxia, prove of curative value.
2. In certain chronic diseases of the larynx it may allow

* Read before the American Laryngological Association at its ninth annual congress.



one to delay tracheotomy, and may sometimes relieve or cure the patient.

3. In the treatment of croup it delays asphyxia and allows an easier introduction of air, and the administration of agents capable of modifying the diphtheritic inflammation.

4. It can only very rarely supplant tracheotomy, which is the principal means of opposing croup when medical measures fail.

The last declaration proved the text for a discussion which was "an extinguishment of M. Bouchut's views and methods," and intubation of the larynx was condemned as an impracticable procedure.

In M. Bouchut's experiments a tube was used from 18 to 24 millimetres long, and from 6 to 8 millimetres wide, narrowed at one end. This was pressed into the larynx on the end of a hollow sound, a thread having first been attached to it to prevent its passage into the trachea, and to facilitate its removal. This thread was brought out through the mouth, and seems to have been the cause of much irritation; but the larynx was tolerant of the tube. Previous to Bouchut's experiments and since that date, catheters have been frequently used to prevent suffocation from closure of the glottis. As early as 1801 Desault accidentally learned of the tolerance of the larynx and trachea for a foreign body of this sort by passing a tube through the nose into the trachea, instead of into the œsophagus, as he had intended. The tube remained in that position for several hours, and he only became aware of its situation upon attempting to introduce food.

This accident suggested the possibility of treating laryngeal stenosis similarly. He experimented and reported two cases. The first patient was relieved temporarily, but died the same day the catheter was introduced. His second, who

had œdema of the glottis, recovered, the catheter having been retained in the trachea for a day and a half.

Within the last few years Schroetter has successfully treated chronic stenosis of the larynx by the use of hollow three-sided bougies.

In 1880 Dr. William McLean, of Glasgow, reported three cases in which he had used a catheter in the larynx, one end of which protruded from the mouth. In one case the catheter was used during a surgical operation to prevent blood from flowing into the trachea. In the second case a No. 12 catheter was retained thirty hours, and in the third thirty-six hours.

Numerous other physicians have practiced catheterization of the larynx, but with no great success.

Dr. Joseph O'Dwyer, of New York, in 1880 began a series of experiments with intubation, which have resulted in giving to the profession one of the most useful operations of modern times. He first tried a bivalve elliptical tube with narrow transverse diameter, and having a head to prevent it from slipping into the trachea. But the membrane soon protruded between the blades, and there was a consequent return of dyspnœa. Retaining the head, he next made plain tubes about an inch in length. These were employed in three cases which he reported: The first was that of an infant, aged two months and twenty-four days, suffering from suffocative diphtheritic croup; relief was promptly obtained, but the child died in seventeen hours. The second case was that of a girl aged three years and a half, who was suffering from urgent dyspnœa. She made a rapid recovery. The third case was that of a boy aged four years; he died in twenty-four hours. At the autopsy the lower end of the cannula was found obstructed by a thick deposit of membrane. This showed the necessity for longer tubes. They were made

and tried, but in a large proportion of the cases they were soon coughed out. A tube was then tried having a wedge-shaped piece of metal on either side to make it self-retaining, but it was held so firmly in the larynx that it could only be removed with great difficulty. Dr. O'Dwyer then conceived the idea of fusiform tubes which, with slight modifications, were like those in use at the present time. His present set of instruments consists of a gag, five laryngeal tubes, an applicator, an extractor, and a gauge. The tubes vary in length from an inch and a half to two inches and a half, the caliber of the largest being about one eighth by one quarter inch, that of the smallest about one half that size. At the upper end of the tube is a diamond-shaped head, with rounded angles, which rests upon the ventricular bands and prevents the tube from slipping into the trachea. The anterior aspect of the head is beveled off where it rests against the base of the epiglottis, and at its anterior part is a small eye through which a double thread is passed during its introduction. About the middle of the tube is a fusiform enlargement, designed to make it self-retaining. Jointed obturators accompany each tube, the distal end of which is rounded and of a size to close the caliber of the tube. At the proximal end also the obturator is enlarged to accurately fit the tube, and in its base is a small hole into which the end of the applicator is screwed when the tube is to be introduced. The stem of the applicator is covered by a sliding tube, which may be crowded forward by a thumb-piece to release the obturator from the laryngeal tube when the latter is in position in the glottis. The extractor is constructed on the principle of a dilator. When in use the closed blades are passed into the end of the laryngeal tube; a lever on the handle is then pressed down to open the blades, which impinge against the inner aspect of the tube and hold it firmly so that it may be withdrawn. The gauge

is used in determining the size of tube necessary for a child of any given age.

You will find no difficulty in doing intubation; but those not familiar with laryngology will find it profitable to practice on the cadaver before attempting it on the living subject.

The Operation.—The child should be wrapped in a shawl and held in the nurse's lap, with the head thrown slightly backward against her left shoulder. The gag is then placed between the jaws on the left side of the patient's mouth, and intrusted to a competent assistant, who should hold it carefully in position.*

With the gag in position, the index finger of the left hand is carried over the base of the tongue behind the epiglottis to the opening of the larynx. At this point great difficulty is sometimes experienced in recognizing the epiglottis, which in young children is so soft that it can hardly be felt, though in patients over three years of age there is usually no difficulty. In very young patients the larynx is so small and soft that its outlines are indistinct to the tactile sense. To me it feels much like the end of my ring finger. I avoid trouble with the epiglottis by carrying my finger first behind the arytenoids and then slightly forward. With the finger resting on the larynx, the tube is glided quickly along the palmar surface until its end is lodged in the larynx; it is then gently forced through the glottis until its head rests upon the ventricular bands, where it is held by the index finger of the left hand while the applicator with the obturator is disengaged and withdrawn.

* The gag which goes with this set is too small, and, unless very carefully watched, is liable to become displaced, so that the operator may be bitten. A friend of mine lost his life the past winter from diphtheria caused by a bite which occurred in this way.

I have used latterly Goodwillie's gag, which is easily retained in position; but, as an additional precaution, I usually use a broad steel band on the first finger.

If any difficulty is experienced in introducing the tube, the instrument should be withdrawn after a few seconds to allow the child to catch its breath; then the attempt may be repeated. The double thread attached to the tube before its introduction is allowed to remain for a few minutes until the child has partially cleared the trachea, and respiration has become fairly easy. Then the index finger of the left hand is again introduced for a moment upon the head of the tube, and the thread is cut and withdrawn. The whole time occupied after the gag is in position until the tube is safely lodged in the larynx is seldom more than a minute. Within five or ten minutes more the patient is usually breathing with perfect ease, and falls into a quiet sleep. No anæsthetic is used, and little if any pain is complained of by the patient. Subsequently the child requires no more than the ordinary care for a patient with the same malady who had not required surgical interference, excepting as to nourishment.

The patients should be fed on soft solids, and I believe that fluids must be absolutely forbidden, excepting by enemata. Most of these patients might swallow half a drachm of liquid without harm, if at the time they were always careful to bend the head well forward and a little to one side, with the chin pressed firmly against the neck. Some will swallow without any difficulty even without this precaution, and others will swallow readily a part of the time; however, the entrance of a small amount of fluid into the trachea may be sufficient to excite a fatal bronchitis or pneumonia. The best plan is to forbid the use of fluids entirely, for the child on the second day will beg so for water that the attendants are nearly sure to give it unless they have been told that it will kill the patient. After the second day the thirst seems to be much less troublesome. At the time, this direction seems almost cruel, but there is some reason to believe that

withholding fluids has a decided effect in limiting the amount of diphtheritic deposit in the air-passages, as well as preventing the excitation of bronchitis or pneumonia. At most, the suffering of the patient can not be long, and, in view of the evils to be avoided, I hope those who use intubation will bear in mind the danger from the ingestion of fluids.

The tube in the larynx is cleared by the ordinary respiratory efforts, or, if it becomes clogged, it will usually be coughed out. Not infrequently it will be coughed out during the course of the treatment; but this does not occur in more than one fourth of the cases, and then it is not apt to be more than once. The largest tube that can be used is most likely to be retained. After from four to six days in many favorable cases, the swelling and false membrane will have so much diminished that the tube may be coughed out finally, and need not be reintroduced. If not expelled, it is removed with the instrument designed for the purpose. In removing the tube, the gag should be inserted, and the extractor guided into the tube by the finger of the left hand, when, by opening its blades, the tube is caught and may be extracted. If at the same time the trachea is grasped just below the cricoid cartilage and crowded slightly upward and backward, the liability of forcing the tube into the trachea is diminished. Dr. F. E. Waxham, of Chicago, who, I think, was first after O'Dwyer to adopt this method of relieving the dyspnoea of pseudo-membranous laryngitis, has, I think, done more than any one else, excepting the originator, to popularize this operation. He has experimented quite extensively with tubes of various forms. Recently he had constructed tubes with a very small head, and a rubber collar, fitted with an artificial rubber epiglottis, designed to prevent the entrance of foreign substances into the air-passages during deglutition. He has used these with fair

success, but has not yet overcome this objection to intubation.

Dr. A. E. Hoadley, also of Chicago, by accident introduced one of O'Dwyer's tubes wrong end foremost, and the patient did well for a time. Subsequently he and others employed this method of seating the tube. It was maintained that, instead of resting with its head on the ventricular bands, it could thus be crowded down so that it rested on the true cords, where it did not so much interfere with closure of the epiglottis, and therefore deglutition was more easily accomplished. Cases treated in this way did just about as well as those treated by O'Dwyer's method, I think, neither better nor worse.

Dr. Hoadley has had tubes constructed much shorter than O'Dwyer's, and with somewhat modified heads, designed to rest on the true cords. He thinks they will be more satisfactory than the longer tubes, but he has not used them. None of these are very different from some of O'Dwyer's patterns. Dr. J. Tascher, an eclectic physician of Chicago, has recently been experimenting with a short tube quite different from O'Dwyer's, with which he has had good success, having treated six patients, of whom three recovered, though in one of these the lower end of the tube became filled with false membrane, and the child nearly suffocated before it could be removed. It will be remembered that it was the liability to this accident which caused Dr. O'Dwyer to adopt the long tube. Dr. Tascher's tubes are made of German silver and are very light, with a comparatively large caliber. There are six in a set, varying in length from $\frac{3}{4}$ to $1\frac{1}{4}$ inch. They are of uniform size from the slight collar which forms the head to the lower end, and have no bulging upon the side to secure more perfect retention, which he maintains is unnecessary, on account of the position which the head occupies below the ventricular

bands. These tubes are flattened at the sides and have an oval aperture measuring from $\frac{1}{8}$ by $\frac{1}{4}$ inch to $\frac{1}{4}$ by $\frac{3}{8}$ inch. The collar which forms the head is only about $\frac{1}{16}$ of an inch in width. The outer edge of its lower surface, which is designed to rest directly upon the vocal cords, projects a trifle below its attached border to prevent it from slipping off the cords.

On a wet preparation of a child's larynx it has been demonstrated that this collar catches so firmly on the vocal cords that the tube can not be forced into the trachea even by using considerable force.

While this is true with this particular larynx, and although the doctor states that there is no danger whatever that the tube will be crowded into the trachea, there remains a fear that this accident may occur at times, and this fear becomes the more real from a knowledge of the fact that, at least in one case,* even O'Dwyer's tube, with its large head, has been crowded down into the trachea and caused death. With the small tubes of Dr. Tascher's it would seem that, even if they were crowded into the trachea, they would not greatly obstruct it and might be easily removed by tracheotomy, or possibly with a long tracheal forceps. The advantages of these small tubes, if they were only longer, are at once apparent, if it is a fact that there is no danger of their passing into the trachea. They are small and light, and may be so deeply seated that they do not greatly interfere with deglutition; but it remains to be seen whether they are more likely to cause ulceration of the vocal cords, and whether subsequent cases will average

* It is hardly necessary to state that this case has not been reported. The knowledge of it came to me through a physician for whom I had performed intubation. He told me that the child had recovered from diphtheria, and that, on attempting to remove the tube, the accident occurred with the result stated.

better than those treated by O'Dwyer's tubes. These, like the other modifications of the laryngeal tube, are introduced and removed with Dr. O'Dwyer's instruments.

I have treated twelve cases of diphtheritic laryngitis by intubation, none of which occurred in my own practice. In only three of these cases had I the subsequent care of the patient, and by a strange coincidence these were the only ones that recovered; however, one other lived for eight days and then died suddenly, an hour after the tube had been removed, either of paralysis or of spasm; and another lived eight days, but then died of pneumonia said to have resulted from exposure after the tube had been removed.

Of these cases, Nos. I to V, inclusive, have been reported elsewhere, but, as two of them illustrate what I wish to say of treatment, I shall be obliged to give abstracts of them here.

CASE I.—Consultation with Dr. A. M. Stout. A little girl two years of age. Diphtheritic laryngitis, with great lividity, dyspnoea, and stridor. Intubation; immediate relief. Death from constitutional results of diphtheria forty hours later.

CASE II.—Consultation with Dr. J. F. Todd. A strong boy five years of age. This was termed membranous croup. There was considerable lividity of the lips, with recession of the chest-walls during inspiration. Intubation; complete relief of dyspnoea. The patient did well for about twenty hours. Bronchitis then developed, and the child died about thirty-nine hours after the operation.

CASE III.—Consultation with Dr. C. J. Creighton. A girl five and a half years of age. Diphtheritic laryngitis, with great dyspnoea. Intubation; complete relief, but death from bronchitis in thirty-six hours.

CASE IV.—Consultation with Dr. E. Garrott. Girl four years of age. Diphtheritic laryngitis, but no membrane in the fauces. Great difficulty in respiration, with recession of chest-

walls. Intubation. Very soon after the tube was introduced the child coughed up a large piece of false membrane, after which dyspnœa was entirely relieved. Prescribed the mild chloride of mercury, gr. $\frac{1}{2}$ to gr. j, every two or three hours. Directed that soft solids be given, but fluids withheld as far as possible. Ice was allowed freely. A little water and milk were given this patient, but she soon learned to swallow half a teaspoonful at a time, when lying on the side, without cough, which would have occurred if it had entered the trachea. However, before this, fluids had been frequently taken which had caused paroxysm of cough. Bronchitis developed, and the second or third day after the intubation there was high fever with numerous mucous râles over the entire chest. The mild chloride was continued during this time, and in addition tincture of nux vomica and carbonate of ammonium, with syrup of ipecac, were given. The fourth day the patient was better. During the latter part of this day the patient managed to get the tube out without cough, but it was not necessary to reinsert it. She made a rapid and complete recovery.

CASE V.—Dr. Lilly's patient, a girl, aged four years and eight months. Diphtheritic laryngitis, lividity, great dyspnœa, and recession of chest-walls. Intubation, with immediate relief. I directed that the child should be fed on soft solids and allowed to suck bits of ice, but that very little fluid be given, and this never in greater quantities than half a teaspoonful. Unfortunately, these directions were not carried out thoroughly, but considerable fluid was given, each draught of which caused severe cough, showing that more or less of it went into the trachea. Twenty hours after the tube was introduced I found the temperature 104.8° , patient extremely restless, face becoming livid, pulse irregular, rapid, and feeble, urine scanty, and respiration sighing and imperfect. All over the chest were numerous sonorous and sibilant râles; indeed, the patient presented all the symptoms of the last stage of diphtheritic bronchitis. Such symptoms I have often seen, but have never before seen the patient survive more than two or three hours. When the child was first seen I had ordered hydrarg. chlor. mite in doses of two grains every two hours, which was still continued;

but at this time I ordered tinct. nucis vom., ℥j; amm. carb., gr. j; syr. ipecac, ℥ xij; and potass. acetat., gr. iv, in syrup of licorice, to be given every two hours alternately with the mild chloride. The following morning the patient had slightly improved, the temperature being only 104°. I then discontinued the mild chloride and ordered the above-mentioned remedies to be given every hour. The relief was most marked, and I have no doubt that the comparatively large and frequently repeated doses of the cardiac and respiratory stimulants saved the child's life. The tube was coughed out and reinserted on the second day, and was again coughed out on the fourth day, but was not needed subsequently. The child recovered slowly, and it was three or four weeks before the signs of laryngitis and bronchitis had entirely disappeared.

CASE VI.—Seen in consultation with Dr. B. A little girl, two and a half years of age, suffering with diphtheritic laryngitis; serious dyspnoea, with recession of chest-walls during each inspiration. Introduction of the laryngeal tube gave immediate relief, but she died about twenty-four hours later with symptoms of diphtheritic bronchitis.

CASE VII.—Consultation with Dr. R. J. Price. Girl, two and a half years of age, suffering from diphtheritic laryngitis, there being no membrane in the fauces. There was great dyspnoea, which must have terminated fatally in a few hours but for the operation. Intubation; perfect relief. Patient did well for six days. Seventh day, peevish and irritable, and looking poorly. The eighth day, better. The attending physician removed the tube, and after half an hour, during which time respiration had been natural, he left the patient. He was called back in about half an hour, and found the child dying, but could not determine the cause. However, he opened the trachea, but without avail.

The cause of death in this case was inexplicable, but it seemed to have been much the same as that in two cases reported to me by Dr. O'Shea, and one of which I had verbal reports from Dr. Waxham. At the time I thought it to have been heart failure. Dr. O'Shea attributed the

death in his cases to spasm. Dr. Waxham could not account for the one of which he told me, but thought it must have been from occlusion of the glottis by partially loosened membrane. It is probable that laryngeal paralysis or spasm was the cause of the fatal termination of these cases, for it is not likely that cardiac failure would have happened to occur at that particular time—half an hour to an hour after removal of the tube—when there had been no evidence of it immediately before.

CASE VIII.—Consultation with Dr. G. V. Bachele. A girl seven years of age had been suffering from diphtheritic croup for five days, and at the time of operation was livid and laboring for breath, with marked recession of the chest-walls. Intubation; complete relief; did well for six days, when the tube was removed. The parents were very careless, and allowed the child to expose herself shortly afterward, whereby she contracted a pneumonia from which she died three days later.

This case I have not counted among the recoveries, though, so far as the operation was concerned, it was entirely successful.

CASE IX.—Consultation with Dr. F. A. Lilly. Boy aged four years and four months. Diphtheritic laryngitis of severe form, severe dyspnoea, the child having already passed into that listless stage which precedes a fatal termination. Intubation; great relief, but the child was so low as to be unable to cough up the mucus from the trachea. Death in twenty hours.

CASE X.—Consultation with Dr. C. J. Creighton. Boy aged four years and three months. Child in almost exactly the same condition as that in the preceding case. Intubation; complete relief from dyspnoea, but the child died in about twenty-one hours.

CASE XI.—Consultation with Dr. B. Girl aged three and a half years. Diphtheritic laryngitis, urgent dyspnoea, and impending death. Intubation; perfect relief. In this case the child ceased to breathe before the tube was inserted, but it was

introduced quickly and artificial respiration was instituted, whereby the patient was resuscitated. Here I had urged the necessity of withholding all fluids, but about fifteen hours after the tube had been inserted I was told that the child had learned to swallow easily, though how long it had been practicing with fluids was not stated. I at once mentally affixed to its record the word dead. The patient died at the end of about twenty-four hours of diphtheritic bronchitis.

CASE XII.—Consultation with Dr. P. Matthei. Boy aged four years. Had been sick five days. Diphtheritic laryngitis, with labored respiration and recession of the chest-walls. Intubation; perfect relief of dyspnœa, and the child, as usual in such cases, soon fell into a quiet sleep. Directed that soft solids be given and ice to quench thirst, but forbade a drop of fluid in any other way. Ordered hydrarg. chlor. mite, gr. j., every hour. The next morning (twenty-four hours later) pulse 132, temperature 100°, a little cough, and easy expectoration, but no signs of bronchitis. The child was now begging for water, but I impressed the friends with the danger, and water was still forbidden excepting by enemata. The child was very restless during the day, apparently on account of thirst, and begged piteously for water, milk, wine, beer, or anything that it might drink. The friends thought he was becoming delirious for want of water. Fearing they would yield, I told them that they would kill the child if they gave it anything to drink. Even the physician, kind-hearted man that he is, interceded in behalf of the child, but I was so strongly impressed with the necessity for the measure that I still firmly refused; and, as the family had just lost one little one from diphtheritic laryngitis after tracheotomy, they were sufficiently frightened to follow my orders, excepting that they gave fluids *per rectum* but once. The second day the pulse was 130, respiration 28, temperature 99·5°. The child had rested quietly through the night and asked very little for water. The mild chloride was now given less frequently—only once in four hours—and alternately with it a grain of quinine. No râles over the chest. The morning of the third day pulse 136, respiration 24, temperature 98°. The patient had rested well, but had eaten little since the operation,

and had had only two nutritive enemata during the whole time, instead of three or four daily, as had been ordered. A very few bronchial râles could be heard at this time. The child had ceased to ask for water. Early the following morning (fourth day), with a slight cough the tube was expelled. Breathing remained easy, so that it was not necessary to reintroduce the tube. Pulse 132, temperature 96.2° . After the tube had been removed milk was given, but some of it found its way into the trachea and excited cough. However, very little trouble was subsequently experienced from this source, and the child made a complete recovery.

Of these cases, those numbered IV, V, and XII indicate the course of treatment which I believe to be most efficient after intubation for diphtheritic laryngitis: 1. Prohibit all fluids excepting by enemata, and insist upon this so forcibly that your orders will be obeyed. 2. As another safeguard, give some preparation of mercury in comparatively large and in frequent doses. 3. In case of the development of bronchitis or pneumonia, give respiratory and cardiac stimulants freely but judiciously.

In Case IV my directions were followed very well, but I allowed water or milk to be given in small quantities, hence the bronchitis.

In Case V fluids were given far too freely, hence the bare escape from death.

In Case XII I told the friends they would kill the child if they gave a teaspoonful of fluid, hence the recovery with but little bronchitis. There may be too small ground for these conclusions, but I am fully convinced of the necessity of withholding fluids excepting when given in such manner that they can not possibly enter the larynx.

There is an old and, it is said, very efficient treatment for acute laryngo-tracheitis and bronchitis, which consists of simply withholding all fluids for forty-eight hours. This gives color to the hypothesis that, after intubation for diph-

theritic cases, this method not only avoids the danger of exciting inflammation, but actually aids in curing that which already exists.

Most valuable and interesting articles on this subject have been written by Dr. O'Dwyer, Dr. Waxham, Dr. Northrup, Dr. Hance, Dr. Caillé, and others. From these and from personal letters which these gentlemen have kindly furnished me, I have obtained reports of over five hundred cases. Briefly, these reports are as follows :

Dr. S. A. McWilliams, of Chicago, reports three cases, one of them in a child under three years of age—all of diphtheritic croup. The tube was worn in them from one half to forty-eight hours. There were no recoveries. The immediate effect of intubation was excellent. In two cases the tube was coughed out, and the parents refused to have it reintroduced.

Dr. William Cheatham, of Louisville, Ky., writes me that he has had fifteen cases of intubation, ten of them in patients under three years of age. Tubes were worn from eighteen hours to four days. There was immediate relief, except in one case. This latter patient was found pulseless; when seen, the tube was introduced, brandy was injected hypodermically, artificial respiration was resorted to, and in half an hour the child was breathing well again. It died in twenty-four hours from heart-failure. There was one recovery among his cases. The doctor says he will never do another tracheotomy for croup, and believes intubation is far better. A majority of his patients died from extension of the membrane, others from heart-failure and asthenia.

Dr. George W. Mason, of Bloomington, Ill., reports three cases, all in patients over three years of age. One case he terms diphtheritic croup, and the others membranous croup. There was relief to respiration in all. The tubes were worn from one to one hundred and twenty hours. There was one recovery. The third patient died from complication of whooping-cough and pneumonia.

Dr. Homer O. Bates, of Chicago, reports six cases, two of

them in children under three years of age. All suffered from diphtheritic croup. The tube was worn from one hour in one case to four days and four hours in another. The relief was immediate. There were three recoveries. Dr. Bates believes intubation a valuable means of relief, and in proper cases the best treatment, but that it can not supplant tracheotomy in all cases. The youngest patient that recovered was eight and a half months old. This patient came near dying from diphtheritic bronchitis, but was finally relieved by the same prescription that I had given in one of my successful cases (No. 5).

Dr. F. Henrotin, of Chicago, reports nine cases, two of them in children under three years of age. These patients were suffering from croup, all but two showing more or less diphtheritic membrane in the fauces. The tube was worn from three to six days. In two cases no relief was given by the operation; in one only partial relief, and in the others there was complete relief from stenosis, and disappearance of its symptoms. He had three recoveries.

Dr. J. L. Mulfinger, of Chicago, reports two cases, one patient being eight, the other five years old, both suffering from diphtheria. One had relief almost at once, and recovered. The other had very little relief, even temporarily, and died in about twelve hours. In the one that recovered there was complete loss of voice for seven days after the tube was removed, and more or less aphonia continued for two months.

Dr. Hopkins, of Buffalo, reported six cases in which impending death was overcome, and life saved by intubation.

Dr. Hailes, of Albany, N. Y., reported two cases in which intubation was successfully practiced.

Dr. John B. Wheeler, of Burlington, Vt., reports the case of a child three and a half years old. There was improvement at once, but the tube became plugged with a large piece of membrane, and the child choked and died in about two minutes. The tube was retained about fourteen hours.

Dr. E. D. Ferguson, of Troy, N. Y., reports one case, in a child three years old, suffering from diphtheria. When the obturator was withdrawn, respiration was stopped completely, and tracheotomy became necessary. The child died in about thirty

hours. False membrane had probably occluded the lower end of the tube.

Dr. Charles Denison, of Denver, Col., reports one case of diphtheritic laryngitis in a child six years old. On introduction, the tube displaced some membrane, and the tube and membrane were immediately ejected, and it was not necessary to reintroduce it. The child was laboring for breath, with its lips purple and its face suffused before the intubation.

Dr. F. Tipton, of Selma, Ala., reports one case in a child four years old suffering from diphtheria. The tube remained in position fourteen days. There was immediate relief, and the child recovered. The same physician reports that one tube went into the stomach, but was passed in ten days without ill effects.

Dr. L. H. Dunning, of South Bend, Ind., reports seven cases, four of them in children under three years of age. Two of them were for diphtheritic croup, five for pseudo-membranous croup. The tube was worn from twelve to one hundred and twelve hours. In five cases there was almost immediate relief. In one case there was relief after reintroduction of the tube. In another case the patient had a violent struggle after the tube was placed, and finally, when death seemed imminent, a pseudo-membranous cast of the larynx and trachea, one inch and a half long, was forcibly ejected from the mouth. This patient made a speedy recovery. The doctor is enthusiastically in favor of the operation, which he thinks simpler than catheterization of the bladder.

Dr. Irwin H. Hance, of New York, informs me that he has had six cases of intubation, all in children under three years of age, four cases of diphtheria, one of which was complicated with scarlet fever, one case of diphtheritic laryngitis, one case of catarrhal croup with extensive bronchitis. The tube was worn from six hours to five days and a quarter. This latter patient recovered; the remaining five died. In five cases there was immediate relief; in one case no relief until after laryngotomy had been performed. In this last-named case there was no relief while the tube was in place. It was placed in the larynx five times, and remained once for twenty-five minutes, without

diminution of the severity of the dyspnœa, which was more severe while the tube was *in situ*.

Dr. Montgomery, of Philadelphia, reports thirteen cases. In no case did death occur in less than twenty-four hours, and the relief from dyspnœa was prompt in every case. Six of his patients recovered. The youngest child, eighteen months old, died on the fifth day in convulsions. The youngest child to recover was two years old. In one case the tube was coughed up and swallowed. It was passed *per anum* two days later with no ill effects.

Dr. A. E. Hoadley, of Chicago, reports nine cases, two of them in children under three years of age. All had diphtheria. The tube was worn from twelve hours to four days. The operation afforded complete relief from the difficult breathing, but there were no recoveries. One of the patients died from pneumonia, one from extension of the membrane into the finer tubes, and seven from the constitutional effects of the disease. He prefers the deep position of the tube.

Dr. J. Tascher, of Chicago, reports eleven cases, three of them in children under three years of age. The tube was worn from eight to seventy-two hours. He says there was immediate relief in every case. He had four recoveries. Four of the deaths were from broncho-pneumonia, one from occlusion of the tube by a large piece of membrane, two from blood poisoning. On six of the patients he used the short tube with small head, already described, and of these three recovered. He states that none of these six patients had much difficulty in swallowing.

Dr. D. O'Shea, of Chicago, reports thirty-seven cases, eight of them in children under three years of age. These patients had diphtheritic laryngitis. The tube was worn for periods varying from six hours to eleven days. He reports fourteen recoveries. In two cases patients had spasmodic action of the larynx after the tube was coughed out, and died in a few minutes.

Dr. A. B. Strong, of Chicago, reports thirty-one cases, eight in children under three years of age. All these had membranous obstruction of the larynx. The tube was worn from a few

hours to seven days. The patients had immediate relief in every instance. There was one recovery. The remainder died the second or third day, usually from bronchitis. He objects to the operation for the reason that patients can not eat with the tube in position.

Dr. F. C. Schaefer, of Chicago, reports four cases. Two of the patients were under three years of age. The tube was worn from one hour to two days. All had diphtheria. There was great relief in all cases except the last one, in which a short tube was used. This child had pneumonia at the time, and there was but slight relief. He had no recoveries. In one case tracheotomy was performed twenty-four hours after intubation, and the child lived thirty hours after the operation.

Dr. A. Caillé, of New York, writes me that he has operated in twelve cases, seven of them in children under three years of age. Seven of these had pharyngeal diphtheria with laryngeal stenosis, four had true membranous laryngitis, and one had urgent stenosis of five days' standing. The tube was worn from four hours to fourteen days. The result was very satisfactory in every case. He had five recoveries. The doctor says he finds that solid food chopped fine and moistened is swallowed fairly well. In addition he gives ice, and stimulates *per rectum*. He gives mercury through the cutis by means of lanolin. He has done tracheotomy twenty-one times with only five recoveries, and says that in the majority of cases he shall intubate. In certain cases of septic diphtheria with stenosis, where proper and sufficient nourishment and stimulation were a *sine qua non*, he might prefer tracheotomy. Recently he has been in the habit of removing the tube after twelve, twenty-four, or thirty-six hours, if the patient does not get enough nourishment, and then, after giving food, medicine, or stimulants by the mouth, he re-introduces it if necessary, repeating this process several times as needed. He gives finely divided solid food moistened with water and no liquids, and says his results have been better since he has followed this plan.

Dr. C. E. Denhard, of New York, writes me that he has operated on twenty-four patients with diphtheria, seventeen of them under three years of age. The tube was worn from two

to eleven days. In every instance there was immediate relief. There were ten recoveries. He says that out of thirty-four cases of tracheotomy he had fifteen recoveries. All who recovered were over three years of age, excepting two, aged two and two and a half respectively.

Dr. W. P. Northrup, of New York, writes me that he has operated on thirty patients with six recoveries. Twelve of his patients were under three years of age. The tube was worn from two hours to seven days. In every case but one there was effectual prompt relief. In that exceptional case the patient died two hours after the intubation from extension of the diphtheritic process. All the patients had albuminuria and diphtheria of the pharynx. Two died from heart failure while apparently doing well. He has never had the slightest accident attributable to the tube, but has found, in the course of his autopsies at the asylum, two ulcers at the lower end of the tube where it rubbed against the anterior surface of the trachea; but he is uncertain whether or not there were defects in the tube to account for the irritation.

Dr. Northrup says his predecessor put a tube into the stomach by mistake. It passed in fifty-two hours unaided and without symptoms.

Dr. Joseph O'Dwyer informs me by letter that he has operated in one hundred and thirty-seven cases of croup since the beginning of his experiments in 1880. Of these he reports twenty-seven recoveries; but he adds that a large number of them were experimental cases before the instruments had been perfected. The average time during which the tube was worn in eighteen cases of recovery was four days and twenty-two hours.

Dr. F. E. Waxham, of Chicago, in addition to the eighty-three cases already reported with twenty-three recoveries, tells me that he has had forty eight additional cases with eleven recoveries, making one hundred and thirty-one cases with thirty-four recoveries. The youngest child to recover was nine months of age, the oldest nine years. He believes the percentage of recoveries under three years better than after tracheotomy, but for patients over three years the percentage after tracheotomy

seems a little better than after intubation. He adds that all the cases operated on were desperate, many of the patients being moribund at the time, and that in no case was the tube introduced until the dyspnoea had become urgent.

Thus, altogether, I have reports of 514 cases, in 134 of which, or $26\frac{7}{10}$ per cent., the patients have recovered. Of these, many were under three years of age, and a number of them recovered. Dr. Waxham states that of fifty-two patients under three years of age, 25 per cent. had recovered. This is certainly a remarkably good showing, for of children under four years in whom tracheotomy has been done for diphtheritic laryngitis, the statements of different authors, though varying widely, seem to prove that not more than 15 or 20 per cent. recover. The statistics of tracheotomy in the same disease for all ages show that from 25 to 30 per cent. recover, but very great disparity will be noted in the results of individual operators. That this disparity is partially due to the operation itself is possibly true, though this I believe is the least of the factors. Much, however, does depend on the judgment of the operator in determining the time for the operation, and on his personal influence in securing the consent of the parents early; much on the amount of care exercised by him in operating only on patients who are likely to recover, and on the subsequent care of the patient; but, most of all, the results will be modified by the epidemic influences and immediate surroundings of the case. It has been found that under the same circumstances as to operator, general surroundings, and treatment, the death-rate will vary greatly in different epidemics.

The same might be said of intubation of the larynx; but in estimating the value of the new procedure we must not forget that, in probably less than 10 per cent. of the cases that have been treated by it, it would have been impossible to obtain the consent of the parents to tracheotomy, and

therefore most of those that have recovered must have perished but for the new method.

Remembering that in the fatal cases many have died of bronchitis or pneumonia, which may have been caused by foreign substances in the air-passages, and considering the satisfactory results in the few cases in which fluids have been withheld while the tube was in the larynx, I feel confident that the percentage of recoveries from this method will be much greater when more care is exercised in this respect.

When medicines fail to relieve pseudo-membranous laryngitis, no time should be lost in providing for the free entrance of air, and for this purpose either intubation of the larynx or tracheotomy should be resorted to. The former may be done more quickly and safely and with less shock to the patient, and with less objection from friends; therefore it should be tried first, unless there is serious obstruction in the fauces or trachea; but the operator should always be prepared to open the trachea in case loosened membrane should be forced down by the laryngeal tube. Tracheotomy should also be practiced in cases where the laryngeal tube from any cause fails to relieve the dyspnœa, unless we have sufficient reason to believe that this operation would also fail. In cases where the operator believes that false membrane is loose in the trachea, no time should be wasted by attempting to remove it with a forceps, for, though this attempt may occasionally be successful, it is much more likely to fail, and then a death will result which might have been averted by tracheotomy. If, however, it is thought best to introduce a forceps into the trachea, Mackenzie's long laryngeal forceps opening antero-posteriorly will be found the best.

While intubation can not always take the place of tracheotomy, it has much to recommend it in the majority

of cases. In conclusion, I wish to state again what has already been said :

1. Intubation may be quickly and easily performed, and with but little danger.

2. Friends readily consent to the procedure.

3. There is no necessity of tedious after-treatment, as the tube is kept clear by the respiratory efforts.

4. The results so far are practically as good as those of tracheotomy at all ages, and apparently better in very young children.

5. To secure the best results, great care must be taken to prevent the entrance of foreign substances into the trachea.

6. At present, with O'Dwyer's tubes, the most successful plan is to absolutely prohibit the deglutition of fluids while the tube remains in the larynx. Small bits of ice may be sucked to allay thirst; soft solids may be swallowed, and fluids may, if necessary, be supplied by enemata, or the tube may be removed to feed the patient, and then be re-introduced.

7. Tubes with smaller heads, designed to rest on the vocal cords, have not yet been used sufficiently often to enable us to speak positively about them. If experience proves that they do not often slip into the trachea, and that they do not injure the vocal cords, they will be especially useful, for they will nearly overcome the difficulty in deglutition, and patients wearing them may eat and drink at pleasure, excepting when paralysis or some other result of the disease prevents closure of the epiglottis.

8. Medical treatment should be carefully attended to after intubation, and we must spare no effort to prevent extension of the disease to the bronchial tubes, or to relieve the dyspnœa which it occasions. I apprehend that successful after-treatment depends largely upon the judicious and

timely use of suitable expectorants and respiratory and cardiac stimulants.

9. Though short tubes may be used with good results in some cases, the danger of their becoming filled with pseudo-membrane is so great as to render long tubes preferable.

10. Intubation may and should be practiced early, and it does not preclude subsequent tracheotomy.

11. For serious cases of spasmodic croup, and for œdema of the glottis, this will prove a most useful procedure. Lastly,

12. For the treatment of chronic laryngeal stenosis this method will, doubtless, be of value.

For many months this new operation received somewhat more of praise than it deserved, but already it is receiving unjust criticisms, which may possibly more than offset the praise; but ere long it will find its proper place among the measures for relieving suffering and prolonging human life, and by and by a multitude of those who have been saved by intubation will rise to thank not only its originator, but also the liberal profession which keeps no secrets in the healing art, but freely bestows its blessings on mankind.

Considering what has already been accomplished, we must acknowledge our debt of gratitude to Dr. O'Dwyer for perseverance in perfecting this operation, and for demonstrating its practicability, and we must thank Dr. Waxham and others for their enthusiastic employment of it, which has led so many physicians to test its merits.



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